
CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

✓ The present application claims the benefit of U.S. Provisional Application Serial No. *B1* 60/162,959, filed November 2, 1999, entitled Combustion Chamber Design for a Quench Gasifier, which is hereby incorporated herein by reference.

Please replace the first paragraph under the section heading "BACKGROUND OF THE INVENTION" with the following paragraph. A marked-up version of the paragraph is included in the attached appendix with deleted material in brackets, showing that the list of U.S. classes has been deleted. No new subject matter has been added.

✓ Quench gasifiers are used to gasify ash containing hydrocarbon feedstocks such as residual oils, waste lubrication oils, petroleum cokes and coal. A typical quench gasifier design is shown in Figure 1 (Reference: U.S. Patent No. 4,828,579). The feedstock, the oxidant and a temperature moderator (either steam or carbon dioxide) are injected into the top portion of the gasifier through *B2* a burner and are mixed with one another in the reaction zone below the burner. Steam and carbon dioxide (CO₂) moderate the temperatures in the reaction zone and also act as reactants. The partial oxidation reactions that take place in this portion of the gasifier, called the combustion chamber, maintain the combustion chamber temperatures in the 2000 to 3000 °F range. The combustion chamber is lined with refractory materials such as alumina. Approximately 90.0 to 99.5 percent of the carbon in the feedstock is converted to the synthesis gases (syngas).

In response to the Examiner's drawing objections, the Applicant makes the following amendments:

(a) Please ~~replace~~ the second paragraph under the section heading "BACKGROUND OF THE INVENTION," which is the first paragraph on page 2, with the following paragraph. A marked-up version of the paragraph is included in the attached appendix with deleted material in brackets and added material underlined. No new subject matter has been added.

✓ The bottom portion of the quench gasifier, called the quench chamber, is separated from the combustion chamber by the floor of the combustion chamber as shown in Figure 1. The combustion chamber has an internal longitudinal length L_1 , an external longitudinal length L_2 , and an internal diameter D_1 . A portion of the floor of the combustion chamber forms a constricted gasifier throat having an internal diameter D_2 . The quench chamber is partially filled with water and is not lined with refractory. The quench chamber consists of three main components: the quench ring, the dip tube and the draft tube as shown in Figure 1. The main functions of the quench chamber are to cool down the synthesis gases generated in the combustion chamber by mixing them with water and to saturate the gases with water vapor.

(b) Please ~~replace~~ the first paragraph under the section heading "DETAILED DESCRIPTION OF THE INVENTION" on page 3 with the following paragraph. A marked-up version of the paragraph is included in the attached appendix with deleted material in brackets and added material underlined. No new subject matter has been added.

✓ A previous patent (U.S. Patent Number 4,574,002) suggests changing the shape of the gasifier throat to avoid ash deposits and plugs in this area. The wind tunnel shape proposed in U.S. Patent No. 4,574,002 is shown in Figure 2. The combustion chamber again has an external longitudinal length L_2 and an internal diameter D_1 . However, the modified gasifier throat causes the internal longitudinal length L_3 to decrease compared to the length L_1 of Figure 1. Additionally,

the modified gasifier throat has an internal diameter D_3 . This shape provides a better chance of avoiding deposits and plugs in the throat area than the shape shown in Figure 1. However, the wind tunnel shape is also susceptible to deposits and plugs particularly when feedstock contains metals or metal compounds that solidify at temperatures lower than 3000 °F due to the distance of the throat from the burner and its proximity to the quench ring component of the gasifier.

(c) Please ~~replace~~ the fourth paragraph under the section heading "DETAILED DESCRIPTION OF THE INVENTION," which is the third paragraph on page 4, with the following paragraph. A marked-up version of the paragraph is included in the attached appendix with deleted material in brackets and added material underlined. No new subject matter has been added.

✓ This new design will make it possible to control temperatures in any desired range in the throat area up to an upper temperature limit of about 3500 °F. The design proposed in Figure 3 shows an approximate wind tunnel shape, and a combustion chamber having an internal diameter D_1 and a modified gasifier throat having an internal diameter D_4 . The throat does not have to be exactly in the wind tunnel shape. The essential features of this design are that the ratio D_1/D_4 be in the range of 3 to 6 and that the diameter of the throat shape should decrease as you move away from D_1 portion of the throat.

Additionally, please reinstate the subject matter of claims 1-9 of the original application, which were canceled by Preliminary Amendment filed on April 19, 2000. Instead of presenting claims 1-9 as new claims, the Applicant respectfully requests ~~that~~ the Examiner insert the text of the claims at the end of the present specification. Please ~~insert~~ the following five (5) paragraphs at the end of the specification. A marked-up version of these paragraphs is included in the attached

appendix with deleted material in brackets. Applicant has only deleted the original claim numbers which were in parentheses, and has added no new text or new subject matter.

✓ The new combustion chamber throat design, shown in Figure 3 and Figure 4, will be more successful in preventing plugging in the throat area. This design will also eliminate the frequent damages that have occurred to the throat refractory, because silicon carbide and silicon nitride can withstand higher temperatures and the erosive and corrosive effects of vanadium oxide type compounds better than alumina.

This patent suggestion also proposes eliminating the plenum chamber area shown in Figure 2. The quench ring area of the traditional quench gasifier is prone to frequent damage (References: U.S. Patent No. 4,828,580 and Patent No. 4,828,579). This new design (shown in Figure 3) will be more successful in preventing damage to the quench ring than the designs shown in Figures 1 and 2, because the distance between the throat opening and the quench ring is longer ^{by} in the new design. Overall, this new design will improve the gasifier on-stream time (reliability of operations) and thereby lower the gasifier operating cost.

The high temperatures obtained by electrical heating in the throat will also increase the gasification reaction rates and thereby increase the carbon conversion of the gasifier by 0.1 to 3.0 percent. This in turn will increase the syngas production of the gasifier without increasing either oxygen consumption or feedstock consumption.

The use of electrical heating and silicon carbide type refractories in the throat area will also reduce the consumption of the steam as a temperature moderator, because it will not be necessary to moderate the temperatures. Normally approximately 0.25 to 0.35 pound of steam is required for gasification of every 1.0 pound of residual oil or coke or coal. With this new design, the steam requirement will drop to 0.15 to 0.25 pound of steam per pound of feedstock.